DISTRIBUTION, ABUNDANCE, AND SIZE OF PENAEID SHRIMPS IN THE ST. ANDREW BAY SYSTEM, FLORIDA

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ABSTRACT

Shrimp collections were made every 2 weeks at 12 stations in varying depths (1.5-12.2 m) of the St. Andrew Bay system, Fla., from September 1972 through August 1973. The eight species of penaeid shrimps caught in 312 trawl hauls were, in decreasing order of abundance: pink shrimp, *Penaeus duorarum*; broken-neck shrimp, *Trachypenaeus similis*; rock shrimp, *Sicyonia brevirostris*; rock shrimp, *S. dorsalis*; broken-neck shrimp, *T. constrictus*; brown shrimp, *P. aztecus*; white shrimp, *P. setiferus*; and rock shrimp, *S. typica*. Of the total catch of penaeids, 57.7% were of the genus *Penaeus*, 22.6% of *Sicyonia*, and 19.7% of *Trachypenaeus*. Penaeids were more abundant in the sections of the bay system close to the Gulf of Mexico. Seasonal abundance varied for each species. Shrimps of the genus *Penaeus* were larger in deeper sections of the bay. The hydrological characteristics of the St. Andrew Bay system are much more similar to the waters of the Gulf of Mexico than are those of other estuaries of the northern gulf. This similarity probably accounts for the relatively high abundance of shrimps of the genera *Trachypenaeus* and *Sicyonia* in the bay system. Also, this similarity probably delays the gulfward migration of shrimps of the genus *Penaeus* and accounts for their large sizes in the system.

Personal observations made on exploratory collecting trips and on cruises aboard shrimp trawlers within the St. Andrew Bay system in northwest Florida had led us to believe that some species of marine organisms normally found in offshore waters of the Gulf of Mexico occurred commonly within the system. For example, penaeid shrimps of the genera *Trachypenaeus* and *Sicyonia*, which are rare in bay systems of the northern gulf, were observed frequently. Also, shrimps of the genus *Penaeus* appeared to be much larger within the St. Andrew Bay system than other estuarine areas. It thus appeared to us that the penaeid shrimps of the St. Andrew Bay system were unusual in terms of species composition and size.

Although utilization of estuarine waters by populations of shrimps of the genus *Penaeus* is well known (Lindner and Cook 1970; Cook and Lindner 1970; Costello and Allen 1970), the abundance, distribution, and size are not completely described for all penaeid species within many estuarine waters. This information is especially lacking along the northwest Florida coast. The objectives of our study were to estimate these parameters for penaeid shrimps in the St. Andrew Bay system.

STUDY AREA

The St. Andrew Bay estuarine system is located on the northwest coast of Florida between lat. 30°00′ and 30°20′N and long. 85°23′ and 85°53′W. The system consists of four bays—North, West, East, and St. Andrew (Figure 1)—with mean depths of 1.8, 2.1, 2.1, and 5.2 m, respectively, and covers an area of 280 km² (McNulty et al. 1972). Various aspects of the physical and biological characteristics of the St. Andrew Bay system have been presented by Ichiye and Jones (1961), Waller (1961), Vick (1964), Hopkins (1966), Salsman et al. (1966), Cosper (1972), and McNulty et al. (1972).

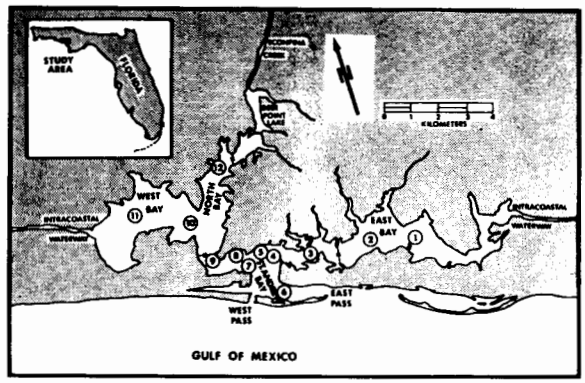

FIGURE 1.—Location of sampling stations in the St. Andrew Bay System, Fla.

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Waters in the St. Andrew Bay system are relatively high in transparency. This high transparency results in part from the porosity of the soils of the watershed, the low freshwater inflow, and the proximity of the system to the clear waters of the northeastern Gulf of Mexico. In terms of extinction coefficients, the transparency of gulf waters adjacent to St. Andrew Bay are typical of clear oceanic waters (Tolbert and Austin 1959).

The bottom of the bay system is composed of distinct sediment regimes. The sand regime (>80% sand) is generally restricted to areas near the passes and in depths less than 6 m. The silt-clay regime (>50% clay, <50% silt, and <20% sand) is located in the deeper waters of the system, but not in the passes (Waller 1961).

The bay system also contains areas covered by rooted submerged vegetation. The submerged vegetation includes turtle grass, *Thalassia testudinum*; manatee grass, *Syringodium filiforme*; and shoal grass, *Diplanthera wrightii*. These grasses cover an area of about 3,200 hectares.

METHODS

Sampling was conducted every 2 wk from 6 September 1972 through 21 August 1973 at 12 stations (Figure 1, Table 1). Two consecutive nights were required to sample at all stations with samples taken between sunset and 0200 h. On 23-24 August 1973 additional sampling was conducted between 1000 and 1400 h at the 12 stations to compare day catches with the night catches of 20-21 August 1973.

Biological samples were obtained at each station with an 11.5-m wing trawl with stretched meshes of 7.6 cm in the wings, 3.8 cm in the body, and 2.5 cm in the cod end. The trawl was towed at about 3.5 knots for 10 min. The entire catch at each station was placed on ice and transported to the laboratory and frozen. Catches were thawed and processed usually within 1 wk of collection. Penaeid shrimps from each sample were enumerated by species, and 30 individuals, or all if less than 30, were measured to the nearest 0.5 cm total length (tip of rostrum to tip of telson).

TABLE 1. — Locations and depth ranges of sampling stations in the St. Andrew Bay system, Fla.

Station	Lat.[1]	Long.[1]	Identifying landmark	Depth range (m)
1	30°05.0'N	85°31.0'W	Goose Point	4.6- 6.1
2	30°06.3'N	85°35.0'W	Shoal Point	7.6- 9.1
3	30°07.6'N	85°37.7'W	Palmetto Point	7.6- 9.1
4	30°09.0'N	85°40.8'W	Redfish Point	10.7-12.2
5	30°09.5'N	85°41.6'W	Baker Bayou	6.1- 7.6
6	30°06.2'N	85°41.3'W	Shell Island	6.1- 7.6
7	30°09.4'N	85°42.8'W	Courtney Point	7.6- 9.1
8	30°10.4'N	85°43.0'W	Lake Huntington	6.1- 7.6
9	30°10.5'N	85°44.2'W	Dyers Point	10.7-12.2
10	30°14.1'N	85°44.3'W	Shell Point	6.1- 7.6
11	30°15.7'N	85°46.6'W	Breakfast Point	3.1- 4.6
12	30°15.4'N	85°40.0'W	Haven Point	1.5- 3.1

[1]United States Department of Commerce, Nautical Chart 868-SC.

Environmental data were also obtained at each station. A water sample for determining dissolved oxygen and turbidity was taken 0.5 m above the bottom at each station with a 3-liter water sampler. Salinity and temperature were determined in situ with a Beckman[2] RS5-3 portable salinometer (accuracy ±0.5°C and ±0.3‰) at the above mentioned depth. Turbidity was determined with a Hach turbidimeter (Formazin turbidity units—accuracy ±0.02 FTU), and dissolved oxygen determined by the modified Winkler method (accuracy ±0.05 ml/liter).

For each species, differences in catch per unit effort (average catch per tow), and in size (average length by date) between subareas were tested statistically with Tukey's w-procedure (Steel and Torrie 1960). For length comparisons, data were used for only those dates when shrimps of a species were caught in all subareas. For comparisons of distribution and abundance, the data were grouped into the following subareas: East Bay (stations 1, 2); North Bay (station 12); West Bay (stations 10, 11); St. Andrew Bay (stations 3-5, 7-9); and East Pass (station 6).

Mean catches per tow and mean total lengths were also compared between upper and lower bay areas. The upper area included all stations in East Bay, North Bay, and West Bay, and the lower area included all stations in St. Andrew Bay and East Pass.

ENVIRONMENTAL FACTORS

Mean values of environmental factors near the bottom were determined for subareas. Salinities and dissolved oxygen were higher in St. Andrew Bay and East Pass than in the other subareas (Table 2). Turbidities in North Bay, East Bay, and West Bay were greater than in St. Andrew Bay and East Pass. Bottom temperatures, however, were similar among subareas.

When subarea data were combined into the respective upper and lower areas, the average values were: salinity—29.2, 33.2‰; turbidity—3.0,

[2]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

TABLE 2. — Annual means and ranges of environmental factors measured in 1972-73 in five subareas of the St. Andrew Bay system, Fla.

Environmental factor	North Bay	West Bay	East Bay	East Pass	St. Andrew Bay
Salinity (‰)					
Mean	27.20	29.08	30.34	32.97	33.27
Range	13.1-32.5	20.5-34.1	25.3-33.9	30.3-35.2	30.6-35.6
Turbidity (FTU)[1]					
Mean	2.69	3.40	2.63	1.09	1.75
Range	0.50-13.00	1.53-7.55	1.50-5.20	0.60-2.15	0.87-4.09
Temp (°C)					
Mean	21.74	21.82	21.79	22.13	21.74
Range	13.1-31.1	13.6-30.2	13.8-29.9	13.0-30.2	13.2-30.0
Dissolved O_2 (ml/liter)					
Mean	3.87	3.77	3.27	4.43	4.01
Range	1.33-5.37	2.06-4.70	1.64-5.58	3.47-5.13	3.13-4.80
No. of samples	26	52	52	26	182

[1]Formazin turbidity units.

1.7 FTU; temperature—21.8°, 21.8°C; dissolved oxygen—3.6, 4.1 ml/liter. Generally, salinity and dissolved oxygen values were higher in the lower area, turbidity values were higher in the upper area, and temperatures were similar between areas (Figure 2). The only noteworthy variation

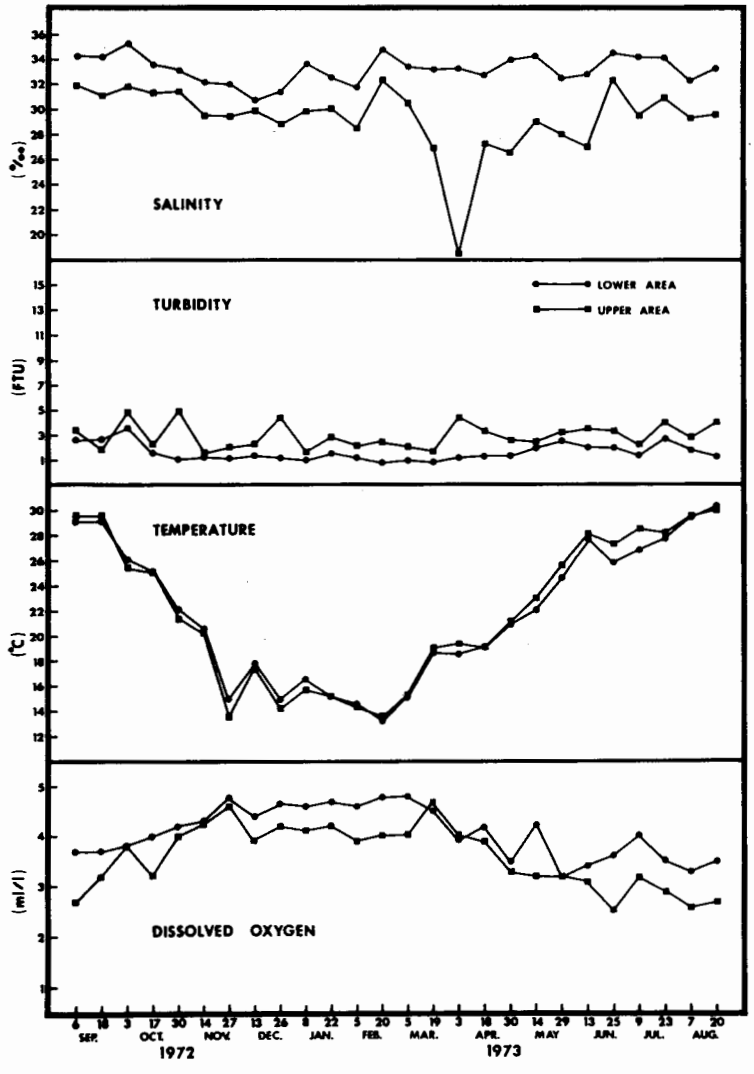

FIGURE 2.—Mean values of salinity, turbidity, temperature, and dissolved oxygen in the upper and lower areas of the St. Andrew Bay system, Fla., 1972-73.

in these values occurred in the salinity of the upper area where heavy spring rains accounted for an exceptional drop in salinity in early April.

Compared to hydrological data from other northern gulf estuaries (Gunter 1950; Swingle 1971; Dunham 1972; Stokes 1974), the values within the St. Andrew Bay system are more oceanic than estuarine (Waller 1961; Hopkins 1966).

CATCHES

Eight species of penaeids were taken during the study: three species of *Penaeus* (*P. duorarum*, *P. aztecus*, and *P. setiferus*), two species of *Trachypenaeus* (*T. similis* and *T. constrictus*), and three species of *Sicyonia* (*S. brevirostris*, *S. dorsalis*, and *S. typica*). Catches of each species at each of the 12 stations are shown in Table 3. The greatest number of individual shrimps (species combined) was taken at station 4 (St. Andrew Bay), the least at station 2 (East Bay). *Penaeus duorarum* was the most abundant species, *S. typica* the least. Since only 25 *S. typica* (ranging in size from 3.5 to 5.5 cm) were caught, this species will not be discussed in the following sections.

Although methods were similar, a striking difference was apparent between our catches and those from other estuarine systems in the northern Gulf of Mexico. In our study, 57.6% of the total penaeid catch consisted of members of the genus *Penaeus*, 22.6% of the genus *Sicyonia*, and 19.7% of *Trachypenaeus*. In contrast, studies in other estuarine systems in Alabama (Swingle 1971), Louisiana (Dunham 1972), and Texas (Gunter 1950; Moffett 1968; Stokes 1974) showed that the genus *Penaeus* represented 99 to 100% of the total trawl catch of penaeids.

DISTRIBUTION AND ABUNDANCE

To determine where shrimp were more abundant in the St. Andrew Bay system, relative abundances were compared by subarea (Table 4). Significant differences were found for four of the seven species: *T. similis*, *S. brevirostris*, *S. dorsalis*, and *T. constrictus*. Either St. Andrew Bay or East Pass or both had significantly greater abundance of these species than the other subareas.

When subarea data were combined for each species and apportioned into upper and lower areas, the relative abundances were greater in the upper area for *P. aztecus* and *P. setiferus* and were greater in the lower area for the other penaeids. Average catches per tow for the upper and lower areas, respectively, were: *P. duorarum*, 110.8, 129.3; *T. similis*, 12.8, 49.4; *S. brevirostris*, 6.0, 51.3; *S. dorsalis*, 2.9, 32.9; *T. constrictus*, 3.1, 14.8; *P. aztecus*, 10.1, 4.6; *P. setiferus*, 2.7, 0.3.

To determine seasonal distribution and abundance, the catches per tow were calculated by area and by date for each species. The results, shown in Figure 3, indicate summer and fall abundances for the three species of *Penaeus*, although not necessarily in both areas. For *Trachypenaeus* and *Sicyonia*, seasonal abundances were evident only in the lower area, with *T. similis* and *S. dorsalis* more abundant during spring and summer, *S. brevirostris* more abundant during winter and early spring, and *T. constrictus* during spring.

TABLE 3. — Total numbers of penaeid shrimps caught in 312 trawl hauls within the St. Andrew Bay system, Fla., from September 1972 through August 1973.

Species	Station 1	2	3	4	5	6	7	8	9	10	11	12	Total
Pink shrimp, *Penaeus duorarum*	3,485	1,613	2,724	1,879	5,097	3,115	3,348	4,767	2,382	3,062	3,371	2,737	37,580
Broken-neck shrimp, *Trachypenaeus similis*	79	1,140	1,553	2,724	101	418	1,095	1,218	1,878	383	7	3	10,599
Rock shrimp, *Sicyonia brevirostris*	12	19	147	984	1,758	3,812	1,552	717	198	17	9	9	9,234
Rock shrimp, *Sicyonia dorsalis*	3	273	632	3,433	66	247	434	226	993	80	0	0	6,387
Broken-neck shrimp, *Trachypenaeus constrictus*	56	53	150	207	704	907	275	248	208	41	93	122	3,064
Brown shrimp, *Penaeus aztecus*	125	81	144	119	19	146	187	165	85	197	342	279	1,889
White shrimp, *Penaeus setiferus*	42	22	18	5	0	0	14	13	21	52	166	71	424
Rock shrimp, *Sicyonia typica*	0	0	0	4	4	12	0	2	3	0	0	0	25
Total	3,802	3,201	5,368	9,355	7,749	8,657	6,905	7,356	5,768	3,832	3,988	3,221	69,202
Rank	10	12	7	1	3	2	5	4	6	9	8	11	

TABLE 4. — Comparisons of mean catch per tow of penaeid shrimps between subareas (Tukey's w-procedure with 125 df) of the St. Andrew Bay system, Fla., from September 1972 through August 1973.

Species	Subarea, mean catch in parentheses and significance lines[1]				
Penaeus duorarum	East Bay (100.4)	North Bay (105.3)	East Pass (119.8)	West Bay (124.4)	St. Andrew Bay (130.9)
Trachypenaeus similis	North Bay (0.1)	West Bay (7.7)	East Pass (15.9)	East Bay (24.3)	St. Andrew Bay (55.0)
Sicyonia brevirostris	North Bay (0.4)	East Bay (0.6)	West Bay (0.7)	St. Andrew Bay (35.4)	East Pass (146.6)
S. dorsalis	North Bay (0.0)	West Bay (1.8)	East Bay (5.5)	East Pass (9.5)	St. Andrew Bay (36.8)
T. constrictus	East Bay (2.2)	West Bay (3.1)	North Bay (4.7)	St. Andrew Bay (11.4)	East Pass (34.9)
P. aztecus	East Bay (4.0)	St. Andrew Bay (4.4)	East Pass (5.6)	West Bay (10.5)	North Bay (10.7)
P. setiferus	East Pass (0.0)	St. Andrew Bay (0.4)	East Bay (1.4)	North Bay (2.6)	West Bay (4.1)

[1]Any two means not underscored by the same line are significantly different at the 5% level.

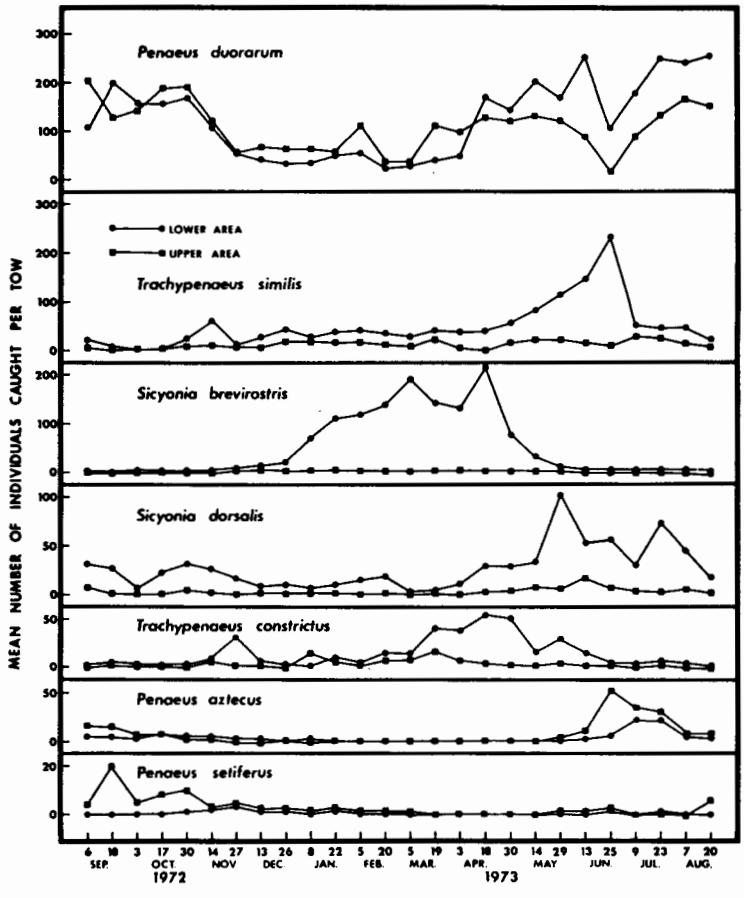

FIGURE 3.—Mean catch per tow of seven penaeid shrimp species in the upper and lower areas of the St. Andrew Bay system, Fla., 1972-73.

Penaeid shrimps taken from the St. Andrew Bay system showed definite habitat preference by genera when abundance was related to depth. As shown in Table 5, the higher mean catches per tow for *Penaeus* occurred in the shallower waters, while those for *Trachypenaeus* and *Sicyonia* occurred in the intermediate and deeper waters of the sampled area. Ninety-two percent of all *Trachypenaeus* and *Sicyonia* were taken from the lower area where the average station depth was 8.6 m.

Day and night comparisons showed mean catch per tow to be greater at night for all seven species (Table 6).

TABLE 5. — Comparisons of mean catch per tow and mean length (cm) of penaeid shrimps in relation to depth and species within the St. Andrew Bay system, Fla., from September 1972 through August 1973.

Species	1.5-4.6 m Stn. 11, 12	4.6-7.6 m 1, 5, 6, 8, 10	7.6-12.2 m 2, 3, 4, 7, 9
Penaeus duorarum	117.5	150.2	91.9
	(9.1)	(9.5)	(10.0)
Trachypenaeus similis	0.2	16.9	64.6
	(6.3)	(6.3)	(6.8)
Sicyonia brevirostris	0.3	48.6	22.3
	(6.1)	(6.0)	(6.2)
S. dorsalis	0.0	4.8	38.8
	(—)	(5.3)	(5.5)
T. constrictus	4.2	15.1	6.9
	(4.7)	(4.8)	(4.9)
P. aztecus	12.0	5.0	4.7
	(11.1)	(12.4)	(12.7)
P. setiferus	4.6	0.8	0.6
	(11.5)	(12.9)	(14.1)

TABLE 6. — Comparisons of mean catch per tow and mean total length (cm) between day and night catches of penaeid shrimps taken from the St. Andrews Bay system, Fla., in August 1973.

Species	Day	Night
Penaeus duorarum	34.8	172.4
	(8.2)	(8.4)
Trachypenaeus similis	0.3	8.0
	(6.4)	(6.2)
Sicyonia brevirostris	0	1.7
	(—)	(7.6)
S. dorsalis	1.2	5.2
	(5.6)	(5.4)
T. constrictus	0	0.3
	(—)	(4.1)
P. aztecus	3.0	9.5
	(13.1)	(13.2)
P. setiferus	0.8	1.5
	(11.1)	(10.2)
No. of tows	12	12

SIZE

Shrimps of the genus *Penaeus* were larger than shrimps of the other two genera. *Penaeus setiferus* had the largest mean length, while *S. dorsalis* had the smallest. Mean total lengths in centimeters and length ranges in centimeters for each species in the St. Andrew Bay system were: *P. duorarum*, 9.5, 4.0-18.5; *T. similis*, 6.6, 3.0-10.0; *S. brevirostris*, 5.7, 2.8-9.5; *S. dorsalis*, 5.5, 2.0-7.8; *T. constrictus*, 4.5, 2.5-8.0; *P. aztecus*, 12.4, 4.5-18.5; and *P. setiferus*, 13.3, 7.0-16.0.

Differences in lengths of shrimps associated with water depth were examined (Table 5); notable differences were discernible only for the genus *Penaeus*, the larger specimens of which generally were found in deeper waters. This relation has also been reported by others (Lindner and Cook 1970; Cook and Lindner 1970; Costello and Allen 1970). Species of *Trachypenaeus* and *Sicyonia* showed little difference in mean lengths with water depths, although the largest mean sizes were found in the deeper zone.

Examination for differences in lengths associated with sampling at night and during the day revealed clearly that hour of sampling had no effect on size of captured shrimps (Table 6).

Comparisons of mean total lengths for the seven species between those subareas from which sufficient data were available showed that the largest shrimps were in either St. Andrew Bay or East Pass (Table 7). However, statistically significant differences were found for only three species: *P. duorarum*, *T. similis*, and *P. setiferus*.

For five of the seven species, larger specimens were caught in the lower area more often than in the upper area. The situation was reversed for *S. brevirostris*, whereas, for *T. constrictus* the mean sizes for the two areas were the same. Mean lengths in centimeters by species between upper and lower bay areas, respectively, were: *P. duorarum*, 9.1, 9.9; *T. similis*, 6.4, 6.7; *S. brevirostris*, 6.3, 5.7; *S. dorsalis*, 5.4, 5.6; *T. constrictus*, 4.5, 4.5; *P. aztecus*, 11.9, 12.8; and *P. setiferus*, 11.7, 14.7.

Shrimps of the genus *Penaeus* were almost consistently larger in the lower area throughout the year (Figure 4). As shrimps of this genus grow larger, they tend to move into deeper, more saline, and less turbid waters.

When present in both areas at the same time, the two species of *Trachypenaeus* were larger in the lower area more often than in the upper, whereas the reverse was true of the two species of *Sicyonia*.

DISCUSSION AND CONCLUSIONS

In general, water depths and salinities are greater, and turbidities, temperature fluctua-

TABLE 7. — Comparisons of mean total length (cm) of penaeid shrimps between subareas (Tukey's *w*-procedure) of the St. Andrew Bay system, Fla., from September 1972 through August 1973.

Species	Subareas, mean total length in parentheses, and significance lines[1]					df
Penaeus duorarum	North Bay (8.89)	West Bay (9.12)	East Bay (9.19)	East Pass (9.77)	St. Andrew Bay (9.81)	120
Trachypenaeus similis	East Pass (5.86)	West Bay (6.20)	East Bay (6.67)	St. Andrew Bay (6.82)		72
Sicyonia brevirostris	St. Andrew Bay (5.66)	East Pass (5.81)				24
S. dorsalis	East Bay (5.37)	West Bay (5.44)	St. Andrew Bay (5.50)	East Pass (6.30)		36
T. constrictus	East Bay (4.23)	St. Andrew Bay (4.43)	West Bay (4.67)	North Bay (4.77)	East Pass (4.90)	10
P. aztecus	North Bay (11.41)	West Bay (11.53)	East Bay (12.50)	St. Andrew Bay (12.79)	East Pass (12.96)	30
P. setiferus	East Bay (11.03)	West Bay (11.68)	North Bay (12.90)	St. Andrew Bay (14.68)		12

[1]Any two means not underscored by the same line are significantly different at the 5% level.

tions, and river discharges are lower in the St. Andrew Bay system than in other northern gulf estuaries (Apalachicola Bay to the Rio Grande River). The dominant group of spermatophytes in the lower area are the submerged sea grasses, whereas in most other northern gulf estuaries the dominant groups are the emergent grasses in the intertidal zone (Kutkuhn 1966). This unusual estuarine environment in the St. Andrew Bay system may induce shrimps of the genus *Penaeus* to remain within the system for longer periods of time, especially in the lower areas where oceanic conditions often prevail.

Such environmental differences probably account for the differences observed in composition, abundance, and size of penaeid shrimps between the St. Andrew Bay system and other estuarine systems in the northern Gulf of Mexico. For example: 1) large adult (total length ranges of 16.5 to 18.5 cm) *P. duorarum* and *P. aztecus* usually occur only in offshore waters, but we caught many of these large specimens throughout the St. Andrew Bay system; 2) in low salinity waters characteristic of other bay systems subadult *P. setiferus* and *P. aztecus* are more abundant than *P. duorarum*, whereas in the St. Andrew Bay system we found subadult *P. duorarum* more abundant than *P. setiferus* and *P. aztecus*; and 3) previous reports indicated that *T. similis*, *S. brevirostris*, and *S. dorsalis* do not ordinarily enter estuaries (Eldred 1959; Joyce 1965; Kutkuhn 1966; Cobb et al. 1973), but we caught many individuals of these species within the St. Andrew Bay system.

The abundance of shrimps of *Trachypenaeus* and *Sicyonia* in the St. Andrew Bay system contrasts sharply with those reported from other estuarine areas of the Gulf of Mexico. Other investigators have included catches made adjacent to barrier islands or tidal passes and reported abundances of less than 1 shrimp per tow. (Dunham 1972; Gunter 1950; Saloman 1964, 1965; Swingle 1971). In our study, average catch per tow (excluding Station 6, which is adjacent to a barrier island) for each species was: *T. similis*, 36; *T. constrictus*, 8; *S. brevirostris*, 19; *S. dorsalis*, 21.

Periods of greatest abundance of *S. brevirostris* in offshore waters of the northwestern and southeastern gulf occur in summer and early fall (Brusher et al. 1972; Cobb et al. 1973). In the St. Andrew Bay system, this species was almost absent during this period. We believe that this shrimp migrates from inshore to offshore gulf waters during spring months.

Means and ranges of total lengths of species of *Trachypenaeus* or *Sicyonia* taken in other estuarine areas were usually less (Swingle 1971; Dunham 1972) than those taken in offshore areas

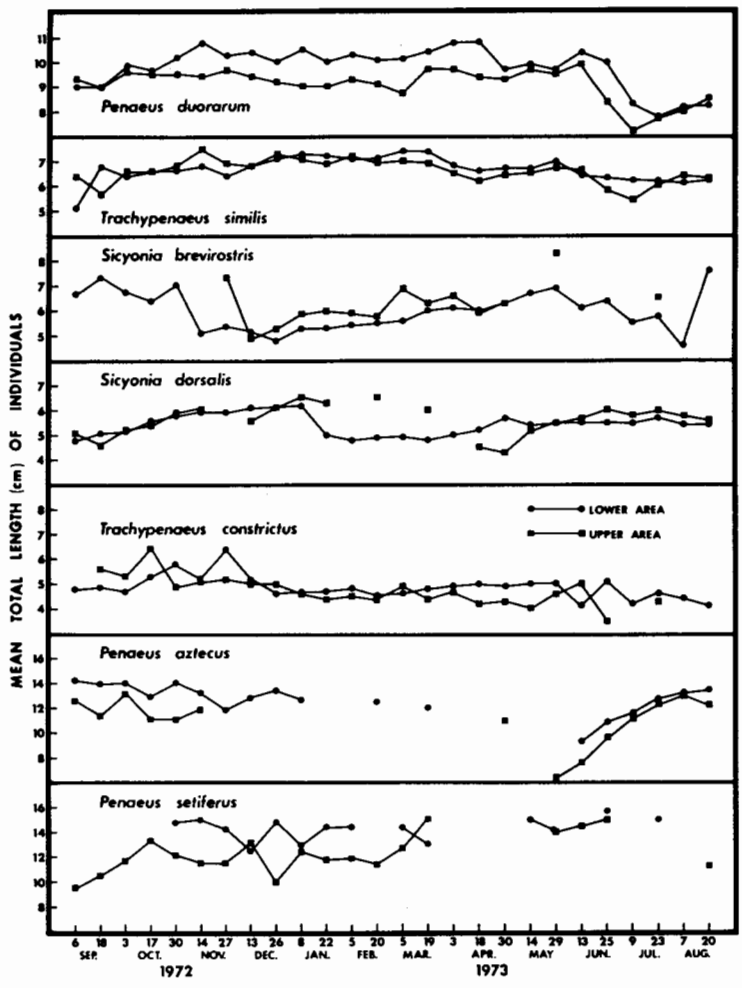

FIGURE 4.—Mean total lengths of seven penaeid shrimp species in the upper and lower areas of the St. Andrew Bay system, Fla., 1972-73.

of the Gulf of Mexico (Brusher et al. 1972). The mean total lengths of the penaeids with the exception of *T. constrictus* (Table 7) were similar to those reported by Brusher et al. (1972) for specimens caught in the Gulf of Mexico. We believe that species of *Trachypenaeus* and *Sicyonia* utilize St. Andrew Bay as a nursery area owing to the similarity of the bay to offshore oceanic habitats.

Of the three species of *Penaeus* caught in this study, *P. duorarum* was the most abundant. High abundance of *P. duorarum* was expected, because the highest concentration of this species in the Gulf of Mexico occurs in the eastern areas (Costello and Allen 1970). Costello and Allen associated *P. duorarum* with grass beds; grass beds are abundant in St. Andrew Bay. Low abundance of *P. aztecus* and *P. setiferus* was expected also, as these are found most abundantly in the northwestern (Texas coast) and north central (Louisiana coast) portions of the Gulf of Mexico, respectively (Cook and Lindner 1970; Lindner and Cook 1970).

Although similar gear and trawling methods were used, mean total lengths and length ranges of *P. aztecus* and *P. duorarum* caught in the St. Andrew Bay system differed greatly from those caught in other gulf estuaries (Saloman 1965; Trent et al. 1969; Dunham 1972). Our catches included many specimens over 13.0 cm total length which, according to Joyce (1965), is well above the size at which shrimps of the genus *Penaeus* are believed to leave estuarine areas. Shrimps of this genus greater than 10 cm total length are usually found in offshore waters (Lindner and Cook 1970; Cook and Lindner 1970; Costello and Allen 1970).

We conclude that the St. Andrew Bay system is unusual among estuaries of the northern Gulf of

Mexico; its environmental qualities which are much more similar to those in the gulf account for the common occurrence in the bay of penaeid shrimps of the genera *Trachypenaeus* and *Sicyonia* normally found in the offshore waters of the open gulf; the unusual environmental factors within the system also delay the migration of penaeid shrimps of the genus *Penaeus* into the open gulf, thereby allowing them to grow larger within the St. Andrew Bay system.

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